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THE INFLUENCE OF CONTRACT TYPE IN PROGRAM EXECUTION / V-22 OSPREY A CASE STUDY

by

Danny Roy Smith

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- ensure an appropriate spread between ceiling and target price in order to adequately incentivize the contractor;
- in teaming arrangements, employ incentives to guarantee the appropriate transfer of technical information; and
- incentivize comprehensive production plans and Production Readiness Reviews.

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The Influence of Contract Type in Program Execution/V-22 OSPREY
A Case Study

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ABSTRACT

The purpose of this study was to look at the impact of a fixed price type contract on program execution of a major weapon system. The full scale development phase of the V-22 Osprey program was used as a case study. The focus of this thesis was to determine the affects of this contract type and identify the actions program management took to address it's influences. The predominant conclusion brought out by this research was that based on the political, historical, and economic circumstances of the period, the fixed price type contract was the best contractual instrument for the government to use. The major recommendations are: in future contracts.

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I. INTRODUCTION

A. BACKGROUND

As Harvey J. Gordon wrote in his article "The Role Of The Contract In Systems Acquisition", there are two ways of looking at any contract - from the view-point of the "seller" or from the viewpoint of the "buyer". Contract types used by the Department of Defense generally differ by the allocation of the program risks between the buyer, and the seller. In the last decade, the appropriate contract type for a given effort has been a topic of lengthy discussion.

One area of the controversy concerns the question of which contract type to use in developmental efforts such as preliminary design (PD) or full scale development (FSD) of military aircraft. Historically, cost-type contracts have been used in these early phases of a major weapon system acquisition. Unfortunately, these cost-reimbursement type contracts have, on-average, shown great overruns in both cost and schedule. It is for this reason, that in the early 1980's, the Department of Defense (DoD) and particularly the Department of the Navy (DoN), took a hard look at new ways of doing business. The use of competition and fixed-price type contracts were incorporated in buying weapons systems in an attempt to more equally distribute the risk and control costs.

One program that has utilized these ideas is the V-22 Osprey. The V-22 is a tilt-rotor aircraft that combines the vertical take-off and landing capabilities of a helicopter with the efficient flight of a turboprop. It is being developed in a joint effort by Bell-Boeing to perform multi-service combat missions for the Marine Corps, Navy, and Air Force.

B. PURPOSE

The V-22 program is currently in full-scale development (FSD). The FSD contract was signed 2 May 1986. The original acquisition strategy called for a cost-type contract. In September 1985 a negotiated cost-plus-incentive-fee (CPIF) contract, agreed to and signed by the contractor, was forwarded to the Secretary of the Navy (SECNAV), John Lehman. He directed that a firm-fixed-price (FFP) contract be implemented. The firm-fixed-price contract directive was compromised to use a fixed-price-incentive-firm (FPIF)[1] contract. This change in contract type made a considerable difference in the motivation and subsequent behavior of both the contractor and the government.

These factors have generated specific questions which this study has sought to answer.

The principal research question is:

- How did the change in contract type influence program execution on the V-22 Osprey?

The secondary research questions are:

- What was the original contract strategy?
- What were the principal reasons for changing the contract type?
- How has the change in contract type affected principal program management parameters?

[1]The FPIF contract is frequently referred to as Fixed-Price-Incentive-Fee. The Federal Acquisition Regulation (FAR) 16.403-1 states the proper terminology to be fixed-price-incentive (firm target).

- What actions did program management and higher authority take in order to address the influences created by the contract type change?
- What conclusions can be drawn from the V-22 program that might be applied to other major defense programs involving similar contractual situations?

C. BENEFITS OF STUDY

This thesis will attempt to provide an independent observation and analysis of the contractual arrangement of the FSD portion of the V-22 Program. Benefits may be derived from this effort in evaluating the appropriateness and success of contract type in this phase of program execution.

Additionally, the conclusions drawn from this work may be useful in decision making on future defense programs considering similar contractual arrangements. These conclusions or benefits may be useful to the aerospace industry as a whole.

D. SCOPE, LIMITATIONS AND ASSUMPTIONS

The major thrust of this thesis will be a case study of the V-22 airframe program, incorporating an historical summary and the reasoning behind the contract change. This thesis will be limited to the FSD portion of program execution and the acquisition strategy leading up to the FSD airframe contract. It will only encompass the areas specifically influenced by the difference in contract types, changes in motivation and attitude as the program progressed, and specific aspects that surfaced during or throughout the program.

This study will not attempt to justify the need for the aircraft. Additionally, it will not make hypothetical numerical comparisons of a fixed-price type contract versus a cost-type contract. This thesis is instead a compilation, through extensive interviews and research, of opinions and historical facts from which the findings and conclusions have been inferred.

This effort is somewhat limited by the amount of historical documentation available on events of the program. No classified information is contained in this thesis. A basic knowledge of major weapon system acquisition is assumed.

E. METHODOLOGY

The methodology for collection of research data has been comprised of interviews with program officials, analysis of key reports, review of the acquisition and program strategy, and analysis of the follow-on contract strategy. Additionally, a review was made of all documents in the Defense Logistics Studies Information Exchange (DLSIE). A DIALOG search was also conducted with the PTS Defense Markets and Technology Database.

F. ORGANIZATION OF THE STUDY

This thesis is comprised of five chapters. Chapter II will provide a history of the V-22 airframe acquisition from its early concept until today. Chapter III will address the specifics of the FSD contract. A summary of the interviews and responses will be presented in Chapter IV, followed in Chapter V by the findings, conclusions and recommendations. Two appendices have been included. Appendix A is a chronology of the V-22 program and Appendix B contains a list of acronyms and definitions.

II. EVOLUTION OF THE PROGRAM

A. EARLY PROGRAM DEVELOPMENT

The evolution of the V-22 Osprey program began in the mid-1950's with the development of the XV-3. This was the first tilt-rotor aircraft to successfully convert from helicopter to airplane mode. Bell Helicopter, under sponsorship of the Army, designed, built, and successfully made the first in-flight conversion of the XV-3 in December of 1958.

Research and development continued during the 1960's, but with little government assistance. In 1972, the Department of the Army and NASA, awarded Bell Helicopter a contract to develop two tilt-rotor demonstrators designated XV-15s. In April of 1977, the XV-15 made its first hover flight and in July 1979, a full in-flight conversion from helicopter to fixed wing. In 1980, both demonstrators met their predicted speed and altitude of 300 knots and 16,000 feet respectively.

In 1981, the XV-15 was demonstrated at the Paris Air Show. The Secretary of the Navy, John Lehman, attended the demonstration and was impressed by its performance. The United States Marine Corps needed a replacement for its aging H-46 fleet of helicopters and the XV-15 presented a possible solution. Upon his return, Mr. Lehman directed the Naval Air Systems Command (NAVAIRSYSCOM) to make comparisons of possible alternative solutions and to include the tilt-rotor and other advanced concepts in the analysis. In March 1981, NAVAIRSYSCOM established the HXM Helicopter Weapon System Project Office and assigned the first program manager in June of the same year.

The Iran hostage situation in 1980 had demonstrated a changing threat scenario, directly affecting the mission of the Marine Corps. The HXM project officials decided that based on the comparisons of possible solutions, no other aircraft could provide the effectiveness of the tilt-rotor concept. The Marine Corps, however, feared that development would take too long and desired a more conservative, faster solution.

In August of 1981, the Under Secretary of Defense for Research and Engineering (USD(R&E)) sent a memorandum to the Service Secretaries suggesting that the multiple rotary wing missions of the Army, Air Force, Marines and Navy might best be accomplished by a single advanced aircraft such as the XV-15. In December of 1981, the Secretary of Defense issued a memorandum establishing the Joint Services Aircraft program, JVX. This was regarded as approval for concept formulation, waiving the need for a formal need statement.

The Deputy Secretary of Defense supported the Army as the executive Service of this joint program and recommended a Marine Corps officer be the program manager. The program was to be executed using a fixed-price-level-of-effort contract, in accordance with standard Army development and acquisition procedures. Each service was to reprogram funds to conduct a joint technical assessment of the technology available for the project.

In February of 1982, a group of experts from each of the Services was assembled to study the effort. By May of 1982, the Bell tilt-rotor concept was certified to be the most appropriate technology, and a pre-bidders conference was held. At about the same time, Boeing-Vertol had been awarded a contract by NASA to develop advanced prop-rotor blades for the XV-15. Therefore, anticipating a request for proposal for development of this new joint service aircraft, Boeing-Vertol and Bell Helicopter Textron signed a teaming agreement in preparation for the event.

In June of 1982, the Services signed a memorandum of understanding on the JVX, designating the Army as the executive Service and assigning a Marine Corps Officer as the program manager. In July, the program manager released a draft request for proposal (RFP) to industry, soliciting their comments.

B. EVENTS LEADING TO THE FSD CONTRACT

Significant changes occurred in December of 1982. The USD (R&E) directed the Navy to assume the role of executive Service for the airframe, due to a shift in priorities by the Army. The Army would continue the engine effort. Due to the short notice, a temporary Navy contracting officer was assigned. Additionally, the acquisition strategy was changed to use a cost-plus type contract and the Secretary of Defense directed a Defense Systems Acquisition Review Council (DSARC) review for approval of full-scale development of the JVX program.

Responses to the draft RFP numbered in excess of 250 comments. Using a good portion of these ideas in the revision, NAVAIR approved the acquisition strategy and in January of 1983, the final RFP was released. In February, a permanent Navy contracting officer was assigned.

The acquisition strategy called for at least two contractors to compete and the final selection would be based on a competitive wind tunnel "fly-off". However, even though the period of performance had been extended eight months to allow for additional evaluation and reduced risk, only one proposal was received and that was from the Bell-Boeing team. The commander of the Naval Air Systems Command made the following comment:

> As to why no other proposal was received, it can only be surmised. Even with the expansion of the initial effort to 23 months work, other industry management may have perceived that the Bell-Boeing's lead and prior experience with tilt rotors was insurmountable. Even though NASA's complete tilt rotor data package had been made available, they apparently felt that, without a further expansion of the effort, i.e., 33 months, the probability of winning was low. The Bell-Boeing team had put their company resources at risk and formed working teams while the program was still in the formative stages. No one else made a comparable commitment. [Ref. 1:p. 8]

The contract was awarded in April of 1983 to Bell-Boeing and extensive wind tunnel tests began.

In May of 1983, the Army withdrew from the program entirely, throwing the viability of the project in question. In September of that year the Army re-entered after a Defense Resources Board (DRB) approved its continuation. However, the Army would now utilize the Marine assault version of the aircraft. Work stopped on all Army unique requirements. In addition to approving the continuation, the DRB approved fully funding the common development of the aircraft within the total obligation authority of the Navy. This was intended to strengthen the program by having one Service control the funding. Congress agreed to furnish $88.6 million for fiscal year 1984 effort.

The program was well on its way in the Fall of 1984 and a request for proposal was released to Bell-Boeing for full-scale development. In November, the program manager's charter was signed and the popular name "Osprey" was selected by the Secretary of the Navy. In January it was designated the "V-22 Osprey".

In June of 1985, a CPIF contract proposal for FSD was submitted by the Bell-Boeing team. By that time, the preliminary development phase was nearing completion. Bell-Boeing wanted to maintain the original schedule and began some of the FSD effort prior to the contract award. By September, the cost-type proposal had been negotiated and forwarded to the Secretary of the Navy for approval. Secretary Lehman directed the use of a FP contract.

Analysis of historical data for Department of Defense acquisition during the 1960's and 1970's reflected a pretty poor track record in regards to cost and schedule overruns. The Defense Department each year would go to Congress and request funding to do a specific effort. The next year they would go back to Congress for additional funding with maybe 70% of the originally proposed effort completed. Congress wanted to know why. There was not an acceptable answer. The contractor's reasoning of "we gave it our best effort" was not good enough. Mr. Lehman, weary of justifying these shortfalls, wanted to create an environment that would take the "brochuremanship" out of the process.

Cost-plus type contracts were averaging considerable overruns. They only provided the best effort of the contractor, not a deliverable. There was the appearance of incompetence and lack of discipline. Mr. Lehman's idea was to reduce the risk in the preliminary development or proto-typing phase of a program to a point where a fixed-price contract could be negotiated. This would force the contractor and the government to take a hard look at what they were signing up to and to acknowledge the unknowns.

Bell-Boeing and the NAVAIR matrix had contended that the V-22 was a relatively low-risk effort. This was due in part to the successful preliminary design phase previously conducted. Mr. Lehman was assured that there were few unknowns. Therefore, when the Bell-Boeing contract reached his desk for approval, he directed the use of a FP type contract. This would insure a deliverable and virtually eliminate a cost overrun.

Bell-Boeing and the Navy set to redefining the contract. In May of 1986, a FPIF contract with a target price of $1.714 billion was awarded to the Bell-Boeing team for the airframe.

III. THE FSD CONTRACT

A. INTRODUCTION

In order to fully examine the contractual situation of the V-22 Osprey, an understanding of the contract types is needed. The following is a excerpt from the Acquisition Strategy Guide, published by the Defense Systems Management College at Fort Belvoir, Virginia.

> There are two broad categories of contracts: cost-reimbursable and fixed-price. For cost-reimbursable contracts, the contractor provides best efforts to meet the contract terms and conditions and the government pays all of the allowable costs that meet the test of reasonableness. Risks to the contractor are minimal. For fixed price, the contractor must provide the required product or service at a predetermined price, regardless of the actual cost. Contractor risks are much more severe. Cost-plus-fixed-fee (CPFF) and the firm-fixed- price (FFP) contracts represent the boundaries of the contract-type spectrum with respect to the contractor risk. Within these boundaries, there are a number of possible variations.
>
> - **Cost Plus Incentive Fee (CPIF)** - Used in advanced engineering, systems development, and first production contracts when uncertainties of performance preclude a fixed-price contract but are not so great as to require a cost-plus-fixed-fee contract. A target cost and a target fee are established, together with minimum and maximum fees. Cost overruns and underruns are shared in accordance with a negotiated formula until the minimum or maximum fee is reached. There is no ceiling price.
> - **Fixed Price Incentive Fee (FPIF) [sic]** - Used in much the same way as CPIF, but where there is less uncertainty in establishing a total ceiling price. The FPIF has the same characteristics as CPIF except that a ceiling price is established and there are no minimum or maximum fees. [Ref. 2:5-29]

B. PRELIMINARY DEVELOPMENT PHASE

The acquisition strategy approved in December of 1982, was the combined effort of the Army contracting officer writing the business and contractual matters, and the program manager, writing the schedules and delivery requirements. When

the program was transferred to the Navy, the Navy contracting officer adjusted the strategy to comply with Navy ideology.

This adjustment resulted in a two phase preliminary design effort that preceded award of the FSD contract. There were a number of risk reduction techniques called for, such as: using the flight test, wind tunnel, and design data of the XV-15, examining a broader technology base, and competing the preliminary design effort.

Stage I had three objectives: to substantiate the JVX design; identify potential problems early-on in order to reduce technical and schedule risks; and to "conduct trade-off studies among specific operational requirements, design criteria and configuration variations to obtain the most mission-effective system." [Ref. 3:p. 3]

The second stage of preliminary design which began in May of 1984 was designed to protect the schedule of the 1991 deliverables by beginning work on long-lead items. This included extensive testing leading to the detail design of the ground test article, which was critical to the FSD flight test vehicle schedule. The Decision Coordinating Paper (DCP) stated:

> The products of PD II included defining and designing long lead items for FSD; test of advanced composite components (i.e., the wing, wing support, hub, and blade fold); design and construction of preliminary mockups required for FSD; and initiation of the Integrated Logistics Support (ILS) and system engineering processes. [Ref. 3:p. 2]

As stated previously, Bell-Boeing was the only response received on the competitive solicitation for preliminary development.

C. THE BELL-BOEING TEAMING AGREEMENT

The agreement signed in May of 1982 specified an equal division of effort which included all V-22 contracts with the government within five years after first

production delivery. This division of effort also included any other government tilt-rotor developments started prior to completion of the V-22. It was agreed that there would be cross-participation in all tasks and that all data used for the V-22 would be made available to either partner for any purpose.

In the area of management, a Bell-Boeing executive summary stated:

> **ORGANIZATION AND MANAGEMENT** - A steering committee composed of the presidents of Bell and Boeing will provide advice and guidance and resolve problems which may arise. Bell and Boeing shall establish a Joint Program Office (JPO) to be staffed equally by Bell and Boeing. The Program Director and Technical Director will be appointed by Bell and the Deputy Program Director and Deputy Technical Director by Boeing ···

It went on to say:

> The Bell-Boeing Joint Program Office (JPO) is the single point of contact for the government and provides overall program direction to Bell and Boeing, including Program Policies and Procedures. The JPO, with Bell and Boeing support, has negotiated the FSD contract and established the work split between Bell and Boeing.

For the six full scale development aircraft, called for in the FSD contract, Bell would be responsible for the wing, nacelle, propulsion, and the dynamics. Boeing would assume responsibility for the development of the fuselage, empennage, avionics, and flight controls.

D. INTENT OF THE FPI CONTRACT

When the Secretary of the Navy directed the use of a fixed price type contract, he was attempting to limit the government's risk. It was felt that a CPIF contract would make the contractor less cost conscious and leave the government open-ended in terms of liability. The going-in price of the CPIF would be less than that of a

FPI for like work, but the contractor would be subject to much less risk in terms of cost overruns.

The CPIF contract would theoretically provide greater flexibility in regards to changing direction and monitoring the technical and cost aspects of the contract. However, it was feared it would motivate the contractor to be overly optimistic on the schedule and performance guarantees.

The FPI contract would provide better budget control. The government would share costs to ceiling, but then the contract would become firm fixed price in nature, with the contractor assuming all the costs. This would greatly reduce the government's liability.

The FPI type contract would require specific definition of the technical requirements and better control over the changes process. It was also felt that the FPI contract would require a reduction in the scope of the effort in order to meet the budget restraints.

NAVAIR expected the contractor's position to be one of performing only the proposed development and testing laid out in the contract, with anything else falling "beyond the scope". Unless specifically addressed in the contract, any and all design solutions would be acceptable. However, with the government demanding technical performance regardless of cost, a higher fee was expected due to the increased contractor risk.

Because of these expectations, it was felt that performance guarantees had to be fully and conservatively negotiated. Additionally, the government had to address all desired effort before the contract was signed. This meant that any work required that could not be fully identified prior to contract award would have unknown cost implications. Secretary Lehman had capped the program at $2.5 billion. This was

done in part to prevent scope changes by the government. Additionally, the timely delivery of all government furnished equipment was essential to avoid claims.

E. PROGRAM RISKS

Although the tilt-rotor concept was not new, it would incorporate state-of-the-art technology. The XV-15 was continuing to demonstrate and validate the V-22 design features. The preliminary development phase had defined the performance and dynamic characteristics to an acceptable degree. The overall risk was considered medium.

Technically, the program called for advanced but mature concepts. Over 60% of the structure weight would be advanced composite material. There were data available on composite rotor blades, external fuel tanks and aircraft wing leading edges but nothing to the extent of the V-22 fuselage or wings. Risk of advanced composite technology was considered to be medium, but because of the extent of this application, the risk on the V-22 was evaluated to be medium to high.

Other areas considered of medium risk were the fly-by-wire controls, the air-frame aerodynamics, and the development of the production engine. As with all aircraft development, weight growth posed a problem. Excessive weight growth would adversely impact the payload and range performance. It was felt that the fly-by-wire, advanced cockpit avionics and the advanced composites would moderate the weight growth. However, crash worthiness and survivability requirements would increase the weight growth risk.

F. COMPETITION STRATEGY

The competition strategy called for the prime contractor to compete vendors for all major subsystems and components during the FSD and production phases.

The program would actively implement policies to "break out" high cost components. It would require a complete technical data package (TDP) suitable for competition and require Bell-Boeing to compete against each other beginning with Lot I. Bell-Boeing would be required to submit the TDP in the form of Level II drawings at the end of FSD and Level III drawings by the end of pilot production. Configuration management during FSD was addressed in a special clause in the FSD contract. Also, not-to-exceed options would be used for pilot production aircraft. It was felt that the FPI type contract, not-to-exceeds (NTE) for pilot production aircraft, and competition during the first lot of production would ensure a reasonable program and control costs.

G. SPECIFICS OF THE CONTRACT

The contract was a fixed-price-incentive-firm contract, with incentive on cost only. It required the delivery of a production competition transition plan and an agreement on investment in production tooling. This agreement included all vendor tooling, both first and second source, and prime contractor tooling at a rate sufficient to allow competition to begin in Lot I of the production contract.

The contract requirements were based on performance guarantees as opposed to design specifications. Additionally, it called for specific fatigue test dimensions, weight empty guarantees, and reliability and maintainability equal to or better than the F/A 18.

The contract had a target price of $1.7 billion and a ceiling of $1.8 billion. It provided a 60/40 share line, meaning that a cost underrun would be shared 60 percent by the government and 40 percent by the contractor. A cost overrun would be shared in the same ratio up to a cost of $1.7 billion at which point all cost would

be borne by the contractor. (see Figure 3.1) This equated to an 18% spread between target price and ceiling.

The contract contained a standard eighty percent progress payment clause. Additionally, there were ten contract line items where Bell-Boeing could close out work and receive payment in excess of progress payments. The government would obligate funds against the contract on an installment basis. After the initial funding, additional monies would be authorized and made available for obligation on an annual basis.

The contract included two production options; options 301 and 302. Option 301 allowed the Navy to order 12 pilot production aircraft at a not-to-exceed (NTE) price of $900 million (FY84 $). Eight of these aircraft were to be manufactured by the Bell-Boeing team, as were the FSD aircraft. Bell and Boeing would then separately make two complete aircraft apiece for the total of twelve. The option had to be exercised no earlier than March of 1990 but no later than March 1991.

Option 302 concerned $900 million of special tooling. The option stated that the Navy would pay for the initial production Special Tooling and Special Test Equipment (ST/STE) required for the twelve pilot production aircraft for a NTE price of $300 million. Under a Memorandum of Understanding, Bell-Boeing would then invest the additional estimated $600 million needed for ST/STE to provide a production rate of six aircraft per month in Lot III and eight per month in Lot IV. The contractor could recover the investment cost over a nine year period beginning with Lot I aircraft deliveries. It had an additional provision that the government would reimburse the contractor for all ST/STE costs if the program was terminated before Lot II. If it was terminated after Lot II, the contractor would absorb the cost.

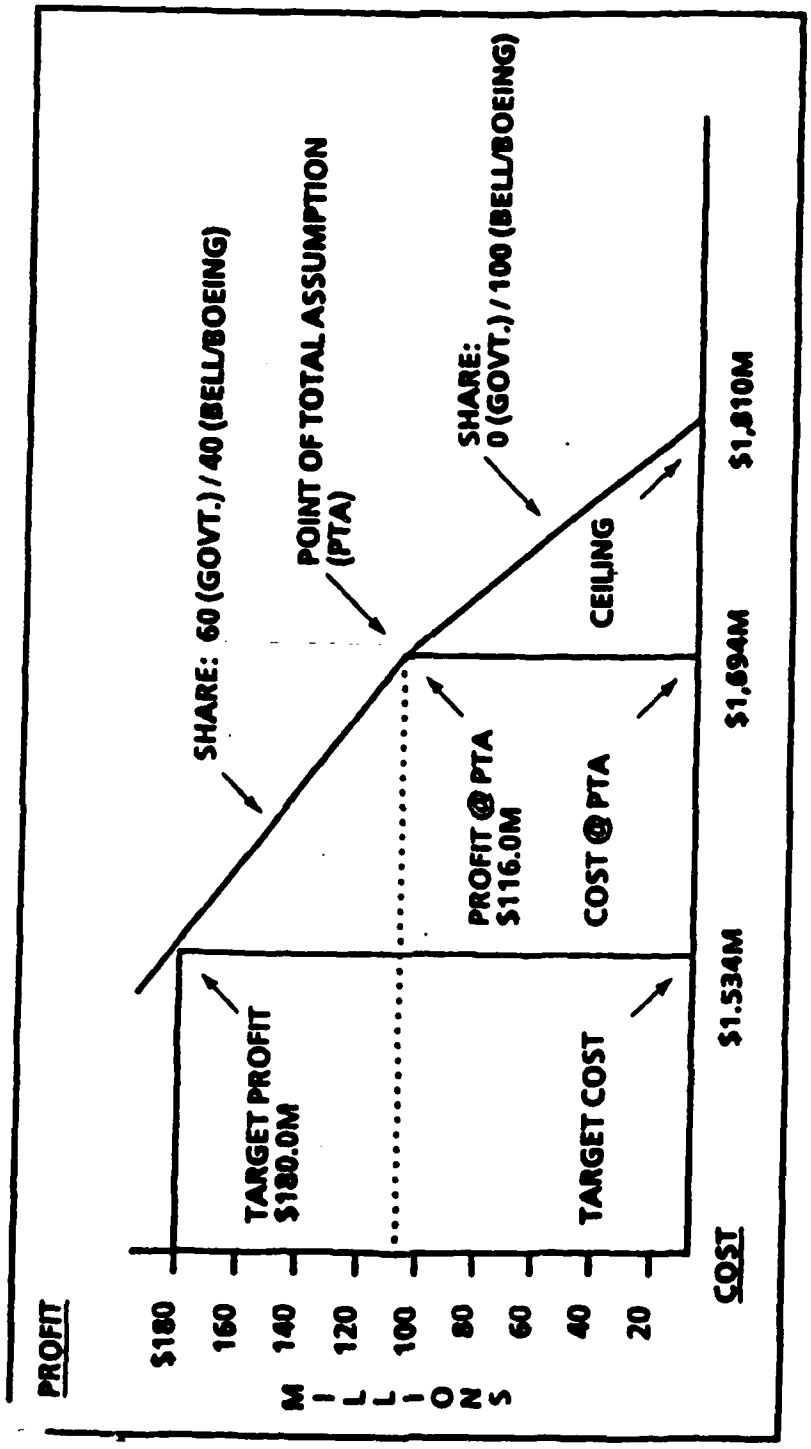

Figure 3.1: Total Contract Profit Vs. Cost ($ Amounts in Millions)

The contract also provided the government the option to acquire unlimited rights to technical data. The option would have to be exercised within one year of the acceptance of the last aircraft to be delivered under the FSD contract. The contractor would provide a complete set of engineering drawings with associated lists and documents for a NTE price of $2.5 million (FY83). Additionally, the contractor would submit a ceiling price for a warranty, on the data supplied, for a period of seven years or until completion of the contract where the data were first used, whichever came first.

IV. INTERVIEW RESPONSES

A. INTRODUCTION

Extensive interviews were conducted with sixteen key government and Bell-Boeing officials. The intent and structure of the interviews was to obtain a very candid opinion of the FSD program and contract. Therefore, specific quotes of the individuals interviewed will not be used and instead composite views will be presented. The interview responses are grouped into five areas: acquisition strategy, technical specifications, issues on contract type, management, and opinions on the success of the program.

John Lehman, in his book *Command Of The Seas*, addressed aircraft acquisition and the strategy he felt would best achieve the Navy's goals. He stated:

> Because of all the different kinds of aircraft needed to do these integrated missions: land-based maritime patrol, land-based Marine Corps support, four-dimensional carrier air wings, and helicopter and VTOL aircraft dispersed through smaller surface ships, the Navy must build, produce, and operate many different types of specialized aircraft. If that aircraft development and production is managed in a tough competitive manner, the existence of a larger number of production lines can be a real benefit to the Navy in bringing the costs down through competition and optimizing for low-rate production. If it is managed on a sole-source basis, it is a formula for unilateral disarmament through the cost escalation brought about by lack of competition and ineconomies of scale from low-rate production lines.[Ref. 4:p. 184]

His administration developed a set of principles that were submitted to the DRB addressing the restoration of Naval Aviation. They were:

- Totally restructuring and toughening up our contracting approach, to end the culture of constant design changes and engineering change proposals (ECPs).

- Requiring the contractors to reorganize their production lines to optimize efficiency at lower production rates.

- Beginning to compete within naval aviation different combinations of aircraft against other combinations of aircraft, to force all the contractors to compete every year.

- Reintegrating Marine aviation with Naval aviation, deploying more Marine squadrons aboard carriers, and having more Navy squadrons assigned ashore with Marine Air Wings.

- Using to the maximum existing aircraft designs. At the time we had only one aircraft in production that was new, the F-18. All the other front-line aircraft were based on designs ten years old; some were more than twenty years old, and a few were more than thirty years old. We wanted to capitalize on the investment in these aircraft because the F-18 had cost the Navy $3 billion before the first aircraft was produced. We intended now to emphasize sticking with proven designs and making planned product improvement by updating them with the latest high-technology.

- Dramatically improving aircraft safety. We were losing about ninety aircraft per year in peacetime accidents. [Ref. 4:p. 185]

Another of his reforms was to limit the tendency towards overspecification. He stated:

> Because of the vastness of the Pentagon bureaucracy, a huge driver of waste and unnecessary cost in all the military departments has come to be overspecification of everything. The specifications for one solicitation for cookies, for instance, ran sixteen pages. We found that the average request for proposal in 1981 carried so many detailed specifications that the document literally could not be carried by one person. Like barnacles, these specifications grow constantly as a result of micro-managing and special-interest legislation on the Hill, by the hundreds of bureaucratic offices within the Pentagon, and because we have learned from hard experience that if you don't have a rigid specification for cookies, some contractors will cut the price and make them with sawdust. [Ref. 4:p. 253]

He went on to say:

> Without question, competition and fixed-price contracts are the formulas for reducing costs in major procurement. But they also can be formulas for disaster, litigation, and claims if a military service does not discipline its tendency to increase capabilities and change requirements during execution - known in the trade as "gold-plating." [Ref. 4:p. 24]

These principles and reforms resulted in positive short-term results. The secretary commented:

> Navy aircraft procurement also shows a dramatic reversal after the application of our reforms. In constant-year 1980 dollars, the average recurring unit price of fiscal year 1986 combat aircraft dropped 33 percent from the average price paid in fiscal year 1982. In fiscal year 1986 alone, that had resulted in savings relative to the budget submitted to congress of approximately 11.3 percent. The year 1986 was the fifth straight year when all naval aircraft procurement programs were on a firm-fixed- price contract basis, precluding the possibility of production cost overruns. Because the price came down on all but one naval aircraft, the navy was able to meet the production numbers needed for a fifteen-carrier battle-group force. [Ref. 4:p. 263]

B. ACQUISITION STRATEGY

As outlined in chapter III, the acquisition strategy for the V-22 Osprey program incorporated many of Mr. Lehman's principles. The government officials interviewed echoed the sentiments of John Lehman in regards to the desired effect of the acquisition strategy. The Navy was tired of going to Congress with a proposal for a new system, asking for X number of dollars, and having to go back to Congress the next year for additional funds with only half the proposed work completed.

Congress had been inferring for sometime that the Navy was incompetent in its ability to control cost growth and overruns. As one government official put it, "it was time to take the 'brochuremanship' out of the process". This was a reference to the contractor down playing the risk of the effort or agreeing to unrealistic specifications in order to get the contract.

Government officials stated that when the V-22 FSD contract was changed from CP to FP, over 1100 specifications or requirements were removed from the CP contract. These were considered too risky for the contractor to agree to. When under the CP type agreement, Bell-Boeing had stated that the unknowns and risk were minimal. Changing to the FP type contract forced them to attempt to address and price all the unknowns.

Government officials made comparisons to other programs where the unknowns had not been successfully addressed or determined. It was felt that this along with "gold-plating" and the unwillingness to wait for block upgrades on product improvements was a major reason for cost growth in other programs. Cost control and competition in the early phases of this program were felt to be very important because by the time the effort has progressed to the production stage it is normally a sole-source situation.

It was the consensus government opinion that the strategy for the V-22 was to reduce cost growth by using more contractor risk sharing. The subject of return on equity (ROE) was brought up and it was stated that statistics at that time showed the ROE for some defense contractors to be very high. This was due to the fact that the government would pay all the up front costs, while the contractor would reap the benefits and profits. For example, all special tooling costs were paid by the government. Additionally, progress payments were as high as 90% at one point. This equated to an improper sharing of risk. It was felt that this improper risk sharing and cost growth were the stimuli for the use of such ideas as early competition, cost sharing of special tooling and fixed price contracts.

Bell-Boeing officials interviewed felt differently about the risk sharing on the V-22 program and the government's acquisition strategy. The normal course of doing business up until this point, was to use a cost type contract for developmental effort such as FSD. They had based many of their business decisions on that premise. It was felt that the preliminary development phase of the program had sufficiently answered enough of the unknowns to proceed to FSD with a cost type of contractual instrument. It was felt that they were as ready as any other previous program to proceed to FSD but there were still items of the project that could not be specifically addressed until later in the process; such as flight test requirements. These unknowns were inherent to developmental programs and impossible to accurately price at this early stage.

When Mr. Lehman directed the use of a fixed price contract along with competition at lot one and a program cap, Bell-Boeing was perplexed. They had felt good enough about the program, up to that point, to invest $100 million in company funds in order to keep the original schedule intact. This money was used for the initial requirements of the FSD effort that was beyond the scope of the preliminary

design contract. Some of this effort consisted of special tooling and engineering design drawings. This was a good-faith effort by Bell-Boeing, therefore they felt they had demonstrated a commitment to the program and were more than sharing the risk by this company investment. Although they were assured by Mr. Lehman that this money and effort would be compensated for in the FSD contract, it put them in a poor negotiating position. If they wanted to recoup their investment they would have to complete negotiations on the FSD contract. The general consensus of the contractor was that it was a "take it or leave it offer" and due to the money they had invested and the company's business base at the time, they were forced to take it.

Government officials made a comparison to commercial contracts. The V-22 acquisition strategy should ensure that the contractor provide an honest assessment of the true risk of the program. Additionally, the strategy should encourage the contractor to pay more attention to the cost growth and ensure a deliverable end item. Those government officials interviewed felt a fixed-price contract not only accomplished these goals, but also made the Navy matrix take a hard look at what they were requiring. If the contractor could not or would not agree to a fixed price type contract, then the program was not ready to proceed to FSD.

Many changes resulted from the $2.5 billion FSD cap John Lehman had put on the program; $1.8 billion of which was allocated to Bell-Boeing. It forced some of the effort to be reduced, some of the effort shifted to government sites and some items changed to government furnished material (GFM) in order for the contract to be mutually agreed upon. Bell-Boeing officials felt that the $1.8 billion cap was an arbitrary number that could be easily sold to Congress and did not reflect realistic assessment of the effort.

The contractors felt that one of the worst elements of the contract strategy was the requirement to compete during Lot one. Looking at the schedule, six months after first flight each contractor would submit their first competitive proposal. All during flight development the companies would be in negotiation. This would encourage the contractors to hold back technical information in order to give each of them an edge during competition. The contract required each team member to certify that the other company had the necessary technical information to build a complete aircraft. In other words, because Bell designed the wing structure, they would certify that Boeing had the necessary information to reproduce the wing structure at their plant. Competition during the period of design would not provide the most effective working environment to ensure the best outcome. Bell might give Boeing the minimum information to construct the wing assembly but hold back ideas or techniques that would help produce it more efficiently.

C. TECHNICAL SPECIFICATIONS

Most of the Bell-Boeing officials and government agents interviewed felt that the V-22 was technically ready to proceed to FSD. It was felt that the program had gone through a detailed preliminary design phase and that most of the necessary questions had been answered. It was felt that the program was based on a low risk approach, on fairly well proven technology and was somewhat conservative in technical risk.

Bell-Boeing felt, however, that neither they nor the government was ready for a fixed price type of contract. The overall consensus of the contractor was that you cannot do a good job at writing a fixed price contract for a developmental project. If you could, you would not need a development program. Flight testing was given

as an example. You can only write the requirements at a very gross level until you start through the program and determine what is needed to be done.

In regards to this, one government official stated that the Navy did not start "with a clean sheet of paper" when the specs were being developed. This referred to the way the specs were "assembled". It was a "cut and paste" type approach of "what did we do last time?". The effort was complicated by the fact that a tilt-rotor had never been designed before. Specs were used from both helicopter and fixed-wing projects. Some of these specs overlapped and it was stated that the government's development of the original specs was probably not well thought out.

The contractor felt that the successful combination of fixed wing and helicopter specs is basically engineering judgment. The development of this sort of aircraft is a compromise of these two types of specification requirements. It was felt that the individual NAVAIRSYSCOM matrix codes, i.e., helo and fixed wing, were very reluctant to compromise their respective pieces of the effort.

One government official interviewed questioned the actual "value" of the government's input to the process; specs included. He stated that the government did not know what they were getting into no matter what type of contract was used. He stated that the government has a difficult problem in determining just what is needed to address the mission effectively. This generally results in overstating the specs in order to cover all the bases. A repeated comment during the interviews was that there was insufficient incentive for the contractor or the government to sign up to realistic specifications under a cost type contract. The "bugs" could be worked out as the program progressed. A government official stated that the contractor generally did not take exception to the requirements of the original specs even in the areas where later it would become apparent he had no intention of meeting the

requirements. He would give it his "best effort". While this is acceptable practice under a cost plus effort, it is not in a FP contract.

Reflecting on this, government officials admitted this could possibly "guarantee failure" of the program. Those interviewed were convinced that if the contract had stayed cost type, the contractor would attempt to meet the high standards proposed. The result would be increased cost, time, and possibly weight. The ultimate outcome of the design would be somewhere between what the government originally proposed and the contractor's more moderate approach. Affordability would come into play with the significant probability of either the scope of the effort being degraded or the program being canceled.

Those interviewed, pointed out how critical the period was when the contract was restructured to a fixed price contract. It was critical in regards to the short period of time spent addressing each aspect of the effort. The government had to take a hard look at what they really wanted. The fixed price type contract would demand very rigid specs. There were approximately three months spent on rethinking the specification requirements that had evolved over the past three years. This can be compared to a 12 to 18 month period normally required to develop specifications for new procurement. It was important that Bell-Boeing expedite the negotiations because they were funding the FSD effort and would not receive progress payments on this work until the FSD contract was signed. The Navy also wanted to get the program under contract to protect the original schedule of aircraft deliveries. It was an extremely short period of time to clarify, eliminate or reduce the scope of the specifications to a point acceptable to both the contractor and the government matrix engineers that developed them. This scrub required engineers on both sides to give up things they felt were important. It proved very difficult to do.

The contractor stated that restructuring the contract called for reducing the specifications to a more "realistic" level. One Bell-Boeing official stated that the "1100" specs deleted from the contract were a number used for "spectatoring". Meaning that each change was broken down to it's lowest level in order to increase the number of specs cut from the contract. It was felt, by the contractor, that the Navy was using this number politically, to justify the use of a fixed price type contract.

Bell-Boeing felt unsuccessful in converting the specifications to a fixed price level. It was impossible to be specific enough in writing the specs. Some of the reworked specs resulted in ambiguities which were open for differences in interpretation. The example given was of clauses in the contract stating: "a detailed plan to be developed". It was stated that in these areas, it was the best statement of work that could be written at the time because of the unknown requirements. However, a dollar and schedule amount had to be applied in order to negotiate the contract at a fixed price level. A preliminary design review had not been done at the time the contract was signed. Bell-Boeing felt the conversion of the specifications was almost an impossible task.

An assumption made by the government was that a fixed price type contract would instill discipline on both sides to stay with the original configuration and not make changes. Cost type contracts were notorious for cost growth due to gold-plating, additions to the scope of the contract, and improvements that "could not wait" for block upgrades. In many cases, some cost growth was due to end running the program manager with low level changes that would, in total, result in significant amounts of money. It was the opinion of those government officials interviewed that this was, if not completely eradicated, significantly reduced with the fixed price type contract.

Parallel development was brought up several times during the interviews. In a cost type environment, several solutions to a known risky area might be worked on concurrently. The idea would be to have a number of different solutions and use the best one at the proper time. If it failed, considerable effort had already been expended on an alternative. This would help ensure staying on schedule. Government officials felt the FP contract did not encourage the contractor to maximize parallel development. It was stated by a key government official, that this was the real test of the quality of the organization; its ability to effectively diagnosis the situation and implement effective solutions. It was felt that Bell-Boeing could have done a better job in this area.

Bell-Boeing agreed there was probably not enough parallel development. There was a gr at deal of concern in controlling cost and this resulted in an optimistic approach in developing alternative methods of design. It was stated however, that in known risky areas, parallel development was applied. One Bell-Boeing official made the statement that there is the problem of coming up with a happy medium between having enough back-up but not over-killing the areas of concern. When there was a choice, fewer solutions were selected over schedule protection. A Bell-Boeing official stated that in hind sight, more parallel development probably should have been done. The use of parallel development was acknowledged in the proposal, but the nature of the FP contract left much of the decision process up to the discretion of the contractor.

Government officials stated that a big problem with a fixed price contract was that, when given a choice, it motivated the contractor to take the least costly alternative. Government officials agreed, across the board, on the effectiveness of using performance specs as opposed to design specs. It was felt that performance specs allowed the contractor some flexibility in meeting the requirements of the contract

while insuring that the aircraft's mission requirements were met. This was especially true where precise design specs could not be written to adequately address the mission requirements. It was felt that performance specs guaranteed the government a good product because it required the contractor to met specific standards such as weight, speed, mission radius, and payload. This would prevent the contractor from making decisions based on cost that might reduce the potential effectiveness of the aircraft. However, as with any contract, any ambiguity in the specs or contract clauses would normally be settled in favor of the contractor. This was especially critical with a fixed priced contract where every change or disagreement had to be negotiated.

D. CONTRACT TYPE/PROBLEMS/ISSUES

Bell-Boeing stated that the contract type change developed an uneasy atmosphere for them. It was stated that the worst thing about a fixed price contract is the possibility of the government changing it's mind about the project and defaulting. This was in reference to a company's ability to average profits and losses over the life of a program and end up successfully with a profit. A fixed price contract placed most of the cost risk on the contractor. The change in contract type did nothing to improve their confidence in the government.

Government officials interviewed pointed out that this fixed price contract actually improved the stability of the program. With cost type contracts, every year a new statement of work, new proposal, and a new budget had to be submitted. Every year the program had to be justified and there was always the uncertainty of whether the effort would be modified due to budget constraints. Even though a cost type contract might have allowed more flexibility for changes, it added uncertainty to the schedule and to the continuation of the program as a whole.

The contractor stated that when John Lehman changed the contract type to fixed price for the same dollar amount, everyone knew the price might stay the same but the effort would greatly change. The CP contract went through a considerable amount of overhaul. The cost risk was shifted to the contractor. Costly items that the government was willing to accept in a cost type contract the contractor was not willing to sign up to under a FP contract. An example given was the single site testing at Pax River. This would require a significant amount of personnel for a period of approximately two years. It would be very expensive and the contractor would not agree to the costs associated. The requirement was changed and the testing was moved to various contractor locations.

A Bell-Boeing official stated that John Lehman had told the contractor that he wanted them to "control the matrix". This was in reference to controlling the tendency of the matrix personnel to make numerous changes and not stick with the original configuration. It was hoped that this would hold down cost and that the fixed price contract would incentivize the contractor to assist in this endeavor. Mr. Lehman had instructed the contractor to go back and restructure the effort to a $1.8 billion figure.

The contractor felt that the NAVAIR matrix is organized to manage cost type contracts. Because of required approvals needed from the government throughout the contract, the contractor felt "over a barrel" to keep them appeased. Bell-Boeing stated that contractors never like to say "no" to customers. When estimating the requirements of a developmental project like the V-22, there are unknowns. There is a spread in the estimates that ranges from optimistic to pessimistic. If the government says the price is too high or the specifications have not been met, rationalization can move a figure to a more optimistic one and engineers will put more effort into the spec in question. However, in a fixed price type contract there was no room for

these contingencies if the contractor is to be profitable. The consensus opinion was that the government managed the program in a cost type manner and Bell-Boeing found it very difficult to "manage the matrix".

Bell-Boeing stated that the effort did not lend itself to a FP type of contract. There was a significant amount of unknowns. These unknowns, however, were not just in the technology. The prototypes had successfully demonstrated the tilt-rotor idea. The unknowns were in areas such as composite fabrication of detailed parts and items such as blade fold. It was felt that a larger risk might be in the development of a producible aircraft the first time around. This type of risk is inherent in a developmental effort.

Government officials pointed out that although incrementally funded, the V-22 program had a payment schedule negotiated for the full term of the contract and the effort was funded to ceiling, not to target. During each twelve month period application was made for the next installment and it was expended based on effort. This made it much easier to budget because the amount was set in the contract. The bottom line was established and there was less chance of an arbitrary decrease in funding.

However, Bell-Boeing was quick to say that because of the narrow spread between target and ceiling, the contract was basically viewed by them as firm-fixed price. The 18% spread provided little incentive to incorporate costly changes that might improve the producibility of the aircraft and too little cushion for unknown problems that might occur. These producibility items would help ease the transition to production later in the program. Those interviewed felt that a 25-30% spread would have been more realistic for this type of effort.

From the government's financial standpoint, there was less involvement in tracking down costs with this type of contract. It was felt that this added a great deal

of stability to the work effort. It was pointed out however, that it was still important to pursue the contractor's progress because of the termination clauses of the contract. It could potentially get to a point where it would be more advantageous for the contractor to terminate the effort than to continue, if the costs significantly overran. A statement was made that one of the oversights of the government's funding policy was the fact that no money was allocated for "misses" in the specs. In other words, no management reserve was allocated within the government's resources.

The statement was made by Bell-Boeing that if put in this situation again, they would insist on a true fixed price statement of work. The Navy would have no right of approval during the design, with very specific criteria for acceptance or rejection. The idea being, we will build it; come pick it up in x number of years. Due to the high standards and rigid specs of the military, normally pushing the state of the art, this is probably not very realistic. Therefore, in the opinion of the contractor, a fixed price contract is not very realistic for this type of effort. The Bell-Boeing officials interviewed felt the best instrument would have been a cost-plus-incentive-fee type contract.

E. MANAGEMENT

When discussing this contract, the overwhelming subject of discussion was the topic of management. Even in a cost type contract there would have been management problems but the contract type made the situation worse. The inherent problems of the teaming arrangement was compounded by competition. Those involved stated there were many unresolved problems between the contractor and the matrix personnel that were pushed up to the program office for action.

A key government official stated that one of his main concerns entering this phase was not so much the technology of the effort but the management of the Bell-Boeing team. It was the feeling that the single most important aspect of this effort was the ability of the contractor to correctly analyze the task within the limits of the contractual arrangement.

One government official interviewed quoted the contractor as saying, "anyone who attempts this effort with a fixed price contract is not in his right mind". His response was that it had worked successfully before and it is a difficult undertaking. But, if Bell-Boeing was not successful it would not be due to the contract type it would be due to poor management.

It was thought that part of the management problem was that the companies did not know each other's abilities. Each company knew they would ultimately compete against each other and were unwilling to give up their perceived "edge". Additionally, each company insisted that a given task should be completed by the inefficient partner in order to ensure a level playing field when they would compete.

A Joint Project Office (JPO) was not a requirement in the contract. When decisions were made that one of the companies did not like, there was the tendency to either drag their feet or not do it at all. The JPO had little authority to enforce decisions. It was felt by some officials, on both sides, that the nature of the effort, solving engineering problems, did not lend itself to working through a joint program office. It had the tendency to complicate and drag things out. It was felt by government officials that more emphasis should have been placed on how the two companies would interact.

The Bell-Boeing officials agreed that the teaming agreement was a problem. The fifty-fifty arrangement meant that every decision had to be done by consensus.

It was referred to by one Bell-Boeing official as the "Noah's Ark Philosophy". Everything was done in pairs. Additionally, with traditional oversight by the government, each decision involved not only one person from Bell and one from Boeing, but also the government personnel involved in the process. It was felt by the contractor that if the Navy wanted to use a fixed price instrument, they should have little interaction in the process. This government interaction, reminiscent of a cost type contract, was said to be one of the worst aspects of the fixed price FSD contract.

The comment was made by a government official that there was a startling difference in management philosophies of the two companies; Bell and Boeing. This was a much bigger contract than either had previously attempted. There were differences in the approach to doing business. Textron, Bell's owners, were concerned with minimizing short term losses. Boeing Corporation was a long-time aircraft manufacturer that knew the industry requirements of long term investment; usually resulting in losses in the early years of a project.

The company's cost schedule control systems were also different. Bell charged proposal preparation to overhead while Boeing charged the preparation directly to the individual contract. Boeing had a somewhat structured management hierarchy that seemed to restrict the flow of information within the company. Bell, less structured, had a more free flow of information. The program was a quantum leap from the million dollar projects of which they were accustomed and the billion dollar V-22 effort.

Company cultures were also discussed with Bell-Boeing officials. It was stated that it would be hard to find two companies with more adverse corporate philosophies. Boeing seemed more concerned with schedule where Bell was concerned with cost. It was stated there seemed to be a lot of short term motivation in a long term industry and that this problem was becoming more common in the aerospace

industry today. The government is concerned with affordability while corporate stockholders look at this year's profits and demand a respectable return on investment.

Statements were made by a government official on how, early-on in the contract, Bell-Boeing was slow in realizing cost growth factors associated with the program. It was stated that efforts by government program officials to point out these factors were discarded by Bell-Boeing. The contractor had stated they were the experts in building helicopters and they had proven means to address the problems. It was felt that the contractor was still in a cost type mind-set. This resulted later, when costs started to mount, in statements from the contractor of "we didn't understand the contract".

Bell-Boeing admitted to difficulties in gauging progress in the early stages of the program. Because Bell made the wing assembly and Boeing the fuselage, interaction was a source of frustration, especially when interfacing the parts. If the mate was off an inch, it presented the problem of finger pointing as to who was at fault.

The comment was made that the government does not know how to manage a fixed price contract, especially when used in an FSD effort. It is difficult to determine at the onset which items are important and which are not. However, the common thought throughout the interviews was that if a fixed price contract was managed right, the only risk to the government would be schedule.

A problem internal to the government was concerning the Army's decision to pull out of the program. Many of the safeguards that were written into the contract were based on sufficient numbers of aircraft being produced. These numbers were based on the stated requirements of the individual Services involved. When the Army pulled out it reduced the number by 231 aircraft. It was felt that this reduced

level would not be high enough to ensure competition and would definitely be below the levels needed to execute the options and ensure the NTEs for the first three lots of production.

The contract did not require the contractor to meet the weight guarantees until Lot one. Because of the decrease in numbers of aircraft, the government would not be able to sustain the options for production and would now have to fund $150-$200 million for weight reduction to meet these guarantees. If the numbers had not been cut, this would have been covered by the NTEs.

The program had no binding requirement for the Army to stay in the program. It was stated that, as far as ensuring the success of the acquisition strategy, the program is not only at the mercy of Congress but is also at the mercy of the Services involved. It was felt that instability like this might discourage industry from participating in future joint projects.

F. OPINIONS OF SUCCESS

Most government officials interviewed stated that, in spite of the problems, the fixed price incentive contract was a good contractual instrument to use on the V-22 FSD phase of the program. Most agreed that a firm fixed price contract, however, would not be the instrument to use. It was felt that a wider spread between target and ceiling price would have provided more incentive and would have been more effective.

It was felt that a major factor in the success of the program was that it was funded to ceiling, allowing more political stability. The main drill was to avoid going back to Congress for additional money. A government official stated that with this type of funding arrangement, the only thing that could happen was an underrun. The contract served the purpose of controlling government costs.

In contrast, one government official felt that the use of a fixed price contract defeated the theoretical purpose of full-scale development. It was stated that if we knew how to write thorough enough specifications, we would not need an FSD phase. The system could go right into production. The purpose of full scale development was to work out the existing unknowns in preparation for unhindered production. In this type of effort, you expect to find new technologies and techniques in order to facilitate the building of the aircraft. These developments should enhance the transition to production.

Continuing, he stated that correcting problems from previous phases and improving methods of manufacturing in this phase should lower cost over the life of the program; that is, reducing life cycle costs. A cost type contract would probably produce a more mature design, thus easing the transition to production. It is extremely difficult, if not impossible, to address these areas when writing a FP contract because they are improvements or solutions to unknown problems. Many decisions in this area were hindered because of the contract type which restricted dollars on the part of the contractor. Even if the corporations invested the required dollars "to do it right", recoupment would only come out of the profits achieved during full rate production. Given the limited defense dollars and the politics of the acquisition process, this would be a high risk venture. It was stated however, that the contractor understood the fixes that had to be made in order to make a producible aircraft. It would just be done over a longer period of time, and possibly require some redesign during follow-on contracts.

Bell-Boeing officials felt that the contract type forced the making of short term decisions. This was in reference to the low priority given to the producibility issues that would be critical for production, during this design stage. Logically, program decisions should be made using calculus of variation. That is, determining the total

effect of the decision over the life of the program. Decisions made on items that were not important now or not politically salable were just shifting cost to later in the program. There is the tendency to compromise improvements in producibility for less cost now. Specifically, transferring effort and shifting cost from FSD out to production.

When government officials were asked if there was a loss of value in the product because of the diminished priority and the shift in effort, the answer was no. The contractor and the engineering community would not build an ineffective or unsafe aircraft. However, with this type of contract, the minimum effort could be expected. The question is, what would be done versus what should have been done.

Bell-Boeing officials stated that there was a cost reimbursable mentality not only with their companies but also with the government. It was said that there had not been the needed cultural changes to go to a fixed price type contract for this type of effort. Their engineers wanted to do A+ work when a D was passing in a fixed price contract. The attitude was not to build the best aircraft but to just meet the spec. This causes the focus to be narrowed to just completing the FSD effort. When asked if because of this, the integrity of the aircraft was in jeopardy, the response was that there was not as much compromise in the quality as in the schedule. A cost type contract would have substantially improved the product by tweaking the technology as the program progressed and improving the schedule by utilizing methods such as parallel development.

One government official suggested that, in theory, the best and most effective way to maximize resources would be to stop work after FSD, fly the aircraft a number of years to find problems, and correct them before production. Obviously, this is impractical. It was the opinion of a key program official that it is impossible for the government to completely control and monitor the costs of a defense contractor. A

fixed price type effort is the best method of forcing the contractor to maximize cost control.

Finally, government officials were asked if they got what they expected. The consensus answer was that it was up to who interprets the performance specs. With a cost type contract, effort would continue until an agreement could be made. With a fixed price contract, there are gray areas in the intent and interpretation of the specs. In most cases these specs would be interpreted differently by the government and the contractor. All government officials interviewed felt, however, that considering the political environment at the time, a fixed price contract was the only way to avoid early cancellation of the program. Therefore, the technical compromises were a necessary trade-off.

It was the general opinion that Bell-Boeing will be very conservative in follow-on contracts. Bell-Boeing stated that they will not agree to assume the degree of risk they did in this FSD contract. Bell-Boeing contended that the full impact of this fixed price contract had yet to be felt.

V. FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

A. INTRODUCTION

The purpose of this study was to look at the impact of a fixed price type contract on the program execution of a major weapon system in full scale development. In order to fully explore this area, the V-22 Osprey program was used as a case study. Because the V-22 program originally planned to use a cost type contract, it provided an excellent vehicle to contrast and amplify the impacts of the contract type. These impacts are addressed in the principal research question of this thesis.

- How did the change in contract type influence program execution on the V-22 Osprey?

The secondary research questions help to identify and demonstrate these influences. The secondary research questions were:

- What was the original contract strategy?
- What were the principal reasons for changing the contract type?
- How has the change in contract type affected principal program management parameters?
- What actions did program management and higher authority take in order to address the influences created by the contract type change?
- What conclusions can be drawn from the V-22 program that might be applied to other major defense programs involving similar contractual situations?

The methodology used to examine these issues consisted of analyzing the historical records, program and contractual documentation, and interviews of the key program officials. Chapter II of this study provided the history of the V-22 program and Chapter III described the V-22 FSD contract and its provisions. In Chapter IV, extensive interviews with government and Bell-Boeing officials detailed the impressions and opinions of the key project issues. The object of this final chapter is to summarize the findings by addressing the research questions and then present the study's conclusions and recommendations.

B. FINDINGS IN RESPONSE TO RESEARCH QUESTIONS

As stated in this chapter's introduction, the secondary research questions develop and basically answer the principal research question. The first two secondary research questions were answered in Chapter II; the history of the program.

- What was the original contract strategy?

The original contract strategy was to have two or more contractors compete in preliminary development and culminate in a "fly-off" to determine the best design. This would determine who would perform the FSD contract. Unfortunately, only the Bell-Boeing team submitted a proposal and the acquisition strategy was changed.

The major changes to the acquisition strategy came, however, when the program was entering the FSD phase. Originally, a cost type contract was to be used for FSD but it was changed to a fixed price incentive contract.

- What were the principal reasons for changing the contract type?

The ideology behind the change can be summarized by the following:

- The Navy wanted to ensure competition and when only one proposal was received, other means had to be developed.
- The Navy wanted to control cost overruns and it was felt that a fixed price contract would help accomplish that goal.
- The Navy wanted to lower the government's liability and used the contract to shift more risk to the contractor.
- The Navy wanted to control cost growth caused by engineering changes known as "gold-plating".

These factors might have been the logic behind the decision, but the principal reason for the change in contract type was that it was directed by the Secretary of the Navy, John Lehman. His philosophy was outlined in the principles developed by his administration and presented in Chapter IV of this study. Basically, he felt that competition and fixed-price contracts were the formulas for reducing costs in major procurement.

Question three addresses the affects of the contract type.

- How has the change in contract type affected principal program management parameters?

The interviews conducted with both the government and the contractor revealed numerous areas that they felt were affected. It is the opinion of this writer, that whether the areas identified were merely perceived to be, or actually demonstrated to be affected by the contract type, is of little importance to this research. If there is the perception that an area has been affected and it is felt that the result

was caused by the contract type, then this perception has, to a degree, affected the process.

The interview responses were the primary source for generating the affects of the contract type on the program. Table 5.1, is a summary of the responses. The table is divided into government, Bell-Boeing, and general responses. Central themes were competition, risk sharing, technical specifications, and management.

The fourth of the five secondary research questions concerned the actions taken to address the affects of the contract type.

- What actions did program management and higher authority take in order to address the influences created by the contract type change?

This area proved to be somewhat difficult to assess. Table 5.2 provides a summary of the responses on the actions taken. It appeared that significant changes in management philosophies and attitudes were made over the course of the contract. Some actions were dramatic but others appeared to be a gradual evolution. The individuals interviewed were quick to point out actions such as the government's intensified monitoring of the progress of the effort or the contractor's attention to the teaming arrangement problems. Other actions required those interviewed to reflect back over the period. The example most often given by the contractor was, that as the contract progressed, more and more attention was given to cost factors, especially as the cost approached ceiling. This encouraged the contractor to probe and scrutinize the contract's terms and conditions in order to maximize the effective use of their resources. Consequently, the government increased it's attention to the contract's terms and conditions.

Table 5.1: Summary of Affects

SUMMARY OF AFFECTS		
GOVERNMENT	CONTRACTOR	GENERAL
Lowered government's risk	Increased Contractor risk	Decreased amount of parallel development effort
Ensured more realistic specs	Increased dissention (Bell-Boeing felt forced to take contract	Did not provide funding for unforeseen problems in original contract
Provided better cost control for the government	Bell-Boeing had to price unknowns	Increased the possibility for tough negotiations on follow-on contracts
Controlled engineering changes (Gold-plating)	Caused feeling of unrealistic assessment of effort arbitrary cap)	Placed greater emphasis on management skills
Ensured "good product" through performance specs	Engineers had to compromise specs, design not fully explored	Corporate philosophies gained importance
Provided competition early and throughout the program	Forced negotiations under pressured conditions	Increased "hands off" attitude of contractor
Provided an option for a data rights package	Bell-Boeing felt wrong type of contract	Increased the importance of military services commitments
Provided some consistency for follow-on contracts through NTE options	Increased pressure on Bell-Boeing from corporate office and stockholders	Shifted cost monitoring responsibility to contractor
Improved justification of program politically Improved stability	Cap and contract type forced de-scope of effort	Greatly increased altercations on interpretation of specs, requirements and contract clauses
Lessened feeling of control (could not make changes)	Affected free flow of technical information between Bell and Boeing (competition)	Shifted effort from government sites
Increased concern on producibility	Slowed progress by inefficient team member doing task (competition) Rushed conversion of specs and requirements (during contract change) CP management on a FP contract Shifted focus a) To cost (schedule impacted) b) To look primarily at FSD phase (production impacted) c) From long term to short term Hindered pride in the product Increased concern on producibility	Increased GFM

Table 5.2: Summary of Actions Taken

SUMMARY OF ACTIONS TAKEN	
GOVERNMENT	CONTRACTOR
Placed more emphasis on contract terms and conditions	Placed more emphasis on contract terms and conditions
Placed more emphasis on control of changes	Shifted emphasis to cost vs. schedule/technical
Increased informal negotiation/communication with contractor	Increased attention to risk
Increased attention on transition to production concerns	Focused on completion of FSD contract
Changed mind-set to FP	Changed mind-set to FP
Placed more attention on schedule/monitoring progress	Increased communication between engineers and management
More closely monitored quality of product	Placed more emphasis on management/ teaming agreement
	Placed more emphasis on ensuring level playing field for future competition

Other management actions also developed as the contract progressed. The importance of schedule and determining the critical path escalated. As these problems developed, attention to management abilities increased. The importance of parallel development became more apparent in this case because of the reduced effort in this area.

Another area that gained attention over the course of the contract was transition to production. As costs increased and requirements were scrutinized, concerns developed on the producibility of the aircraft. If Bell-Boeing was making decisions focused just on completing the FSD contract, it might result in redesign requirements during production. This changed the focus of attention for government officials.

The greatest area of change was the mind-set of using a fixed price type contract. The FP contract required more analysis on proposed changes and improvements because each change required contract modification. Both sides stated that

this was very difficult. Bell-Boeing felt that the government never made the change in mind-set; especially the Navy's matrix engineers. The contractor felt the matrix disregarded the fact that it was a fixed price contract and could accomplish their requests, at the contractor's expense, because of the approval clauses in the contract. The clauses required approval from the appropriate matrix codes in order to proceed to the next stage of effort.

Government officials conceded that it was very difficult to determine how much to intervene in the process. The fixed price contract reduced their ability to make changes, however, it was their responsibility to procure a good product while ensuring the effective and appropriate use of public funds. This greatly increased communication with the contractor.

The last of the secondary research questions was:

- What conclusions can be drawn from the V-22 program that might be applied to other major defense programs involving similar contractual situations?

This question will be addressed in the following section on the conclusions that can be drawn from the study.

C. CONCLUSIONS DRAWN FROM THE FINDINGS

The Navy Program Manager's Guide states:

> It is Department of Defense policy that contract types be employed that are appropriate, considering all the facts and circumstances involved in a specific acquisition. The principal distinction between various contract types lies in the degree of risk assumed by the parties and in the appointment of responsibility. To the extent that the selected contract type reflects a fair and reasonable apportionment of risk and responsibility between the government and the contractor, the contract is more likely to facilitate the efficient conduct of a program. When unilaterally imposed as a substitute for effective program management, either by inadvertently or by design, an inappropriate contract becomes the source of needless, unproductive, and costly controversy.[Ref. 5:pp. 4-23]

The guide defines full scale development in the following paragraph:

> The goal of the FSED phase is to produce a fully tested, documented, and production-engineered design of the concept selected in the D&V (demonstration and validation) Phase. This design must be cost-effective, operationally suitable, and producible. It is developed through an iterative process of design and test-redesign ... [Ref. 5:pp. 1-16]

When comparing this definition of full-scale development with the "textbook" or historical uses for fixed price incentive contracts, there seems to be a mismatch. Looking back on the compilation of the history, research, and interview responses of this thesis, there is a question that must be addressed. What was the main objective of the V-22 FSD acquisition strategy?

In regards to cost control and reducing the government's liability, the fixed price contract accomplished the following:

- Controlled engineering changes
- Demanded a thorough and realistic evaluation of the specifications and requirements
- Eliminated the possibility of requiring additional government funds for the effort addressed in the original contract
- Shifted cost risk and cost monitoring responsibility to the contractor
- Improved political stability.

Given the aforementioned, it is concluded, that the fixed price incentive firm contract was appropriately used to control costs and reduce the government's financial liability on the V-22 Osprey FSD program.

In regards to ensuring the best aircraft being developed, with a mature design that was unquestionably ready for production, the fixed price contract resulted in the following points:

- Incentivized the contractor to focus his attention on cost factors and away from the optimal technical design
- Because of government approval requirements in the contract, it did not effectively control the Navy's engineering matrix codes
- Contract incentives were unsuccessful in motivating the contractor to make decisions that would improve producibility and effectively address the transition to production
- Although modifications to the contract were an option, the fixed price contract was not flexible enough to maximize the developmental effort of the program (i.e., any change to the effort required a contract modification and equitable adjustment)
- Because of the nature of the effort, the contract produced arbitrary clauses and specifications that were open for differences in interpretation and increased the legal liability of the government

The transition to production was an area of great concern for the V-22 program. The Navy Program Manager's Guide states:

> *Transition to Production.* Transition from development to production is not a discreet event. It is an ongoing process which begins with system conceptualization and continues through design, test and production. For instance, planning for production must begin during the design when production engineers work with design engineers to ensure that a producible system is designed. Conversely, design engineers on the factory floor ensure that design related production problems are factored into a producible redesign ... [Ref. 5:pp. 3-40]

One of the primary considerations during FSD should be the successful transition from development to production. Although the tilt-rotor concept was considered mature technology, an aircraft of this size and requirements presented many unknowns. The V-22's extensive use of composites, fly-by-wire technology, and airframe aerodynamics presented challenges that would require "design and test-redesign".

It is therefore concluded, that the fixed price incentive firm contract used on the V-22 FSD Osprey program was not the most effective instrument to ensure the best and most comprehensive technical design.

The political decisions to use fixed price type contracts on developmental projects certainly generated controversy. The question is whether the controversy is "needless, unproductive or costly". [Ref. 5:pp. 4-23] SECNAV Instruction 4210.6 of 20 November 1985, in effect when this contract was ultimately awarded, contained the following paragraph in section 4c:

> *Policy*
> A Systems Commander will not proceed to Milestone II, for a decision to proceed with FSED, until he is satisfied that advanced development has reduced risks sufficiently to enable the contractors to commit to a fixed price type contract that includes not-to-exceed (NTE) prices or priced production options ....[Ref. 6:p. 1]

This ideology changed. Department of Defense Directive 5000.1 of September 1, 1987 contains the following clause in section 9g:

> *Tailored Acquisition Strategy*
> Contract type shall be consistent with all program characteristics including risk. Fixed price contracts are normally not appropriate for research and development phases. For such efforts, a cost-reimbursable contract is preferable because it permits an equitable and sensible allocation of program risk between the contracting parties. [Ref. 7:p. 6]

This clause is interpreted to mean that the use of a fixed price type contract will not be used on future projects such as the V-22 FSD effort unless unusual circumstances warrant. The change in policy is an attempt to more closely match the contract type to the risk of the effort. As stated in the Navy Program Manager's Guide, the contract type should reflect the fair and reasonable apportionment of risk and responsibility between the government and the contractor.

The political environment of any major weapon system program is unquestionably an area that requires risk analysis. However, this area often times does not receive formal or detailed evaluation. This is not to say that politics are overlooked.

In the case of the V-22 Osprey, the political environment at the time played a significant role. Not only was it a Marine Corps project, it took place during a period when cost overruns were commonplace and programs were being canceled due to affordability. Defense contractors were constantly in the headlines for every reason imaginable, including fraud. It was the general feeling on the part of the government that defense contractors were gaming the process and high ROE statistics reinforced those assumptions. The apparent goal of government officials was to prove that costs of major weapons systems could be controlled.

The importance of evaluating the political risks in a major weapon system acquisition such as the V-22, cannot be overstated. When Dick Cheney was selected as Secretary of Defense in early 1989, one of his first actions was to cancel the V-22 program. Although the program was behind in schedule, the fixed price contract had served its purpose in controlling government costs. Additionally, the Osprey had successfully completed first flight in March of 1989. To that point, the program had successfully completed virtually everything that had been originally proposed and without excessive schedule slippage. The Navy submitted a reclama to OSD concerning Secretary Cheney's decision but the DRB supported the cancellation.

Congress immediately passed a unanimous "sense of the Senate" resolution supporting the restoration of the program. This was to say that they were not in favor of the decision to cancel the program. In November of 1989 the defense bill approved by the House and Senate conferees provided $255 million to continue the research and development effort. As the interviews have supported, a CPIF contract would have increased the likelihood of the cost exceeding the ceiling limit. The point is, if the program had been over budget in addition to behind in schedule, there might have been less congressional support.

It is therefore concluded, based on the political, historical, and economic circumstances of the period, that the fixed price incentive firm contract was the appropriate contractual instrument to use on the V-22 Osprey FSD effort. The technical compromises were justified as trade-offs to promote program stability.

Finally, to have a successful program. it must be pointed out that the built-in safeguards of the contract must be supported and used to their full potential. The NTE safeguards built into the V-22 contract were based on sufficient numbers of aircraft. When the Army arbitrarily pulled out of the program, the strength of the contract faltered.

The reduction placed the number of remaining aircraft below the level needed to execute the options and thus ensure the NTEs for the first three lots of production. Additionally, it was not feasible, at that level, to economically engage competition. The Army's pull-out and the resulting reduction in aircraft voided an important safeguard in the contract.

It is therefore concluded, that joint programs must ensure the support and commitment of all Services involved in order to protect the government's overall position and present one face to industry.

D. RECOMMENDATIONS

The following recommendations are offered as a result of this study:

- On any incentive type contract, the spread between target price and ceiling price should reflect the degree of risk facing the contractor. It should be large enough to provide sufficient incentive for the contractor to adequately address the goal of the effort.

- In a teaming arrangement, incentives should be employed to effectively guarantee the appropriate transfer of technical information. This is especially true if competition is advocated early in the program's life cycle. An example of this might be to guarantee a percentage work split between the contractors during the initial production contract. Another example might be an award fee arrangement based on the completeness or quality of the TDP and transfer between companies.

- The contractor should be incentivized to develop a comprehensive production plan culminating in a Production Readiness Review (PRR). A PRR is "a formal examination of a program to determine whether the design is ready for production, production engineering problems have been resolved, and the producer has accomplished adequate planning for the production phase." [Ref. 25:p. A-8] Adequately incentivizing successful PRR's will help ensure that the product is producible and ease the transition to production.

- Department of Defense policy should be developed to control changes in the participation of the individual Services in a joint program. Services should be contractually responsible and required to compensate the program for the impact of their actions. This might be compared to compensation required

when a termination for convenience occurs. These restrictions would help to protect contract safeguards and DoD investments.

- Future projects should ensure that risk sharing and contractual negotiations be conducted under mutual agreement of the parties involved in order to promote a better working environment. This is especially important on development projects.

E. FURTHER RESEARCH

One of the findings of this study indicated that the contract type and its influences could have a significant impact on follow-on effort. It is suggested that the continued study of the V-22 program could prove beneficial. Specific questions might be:

- What has been the technical short fall caused by the contract type?
  - Were the short falls addressed/discovered during Development Test/-Operational Test (DT/OT)?
- What is the projected dollar savings/loss that can be attributed to the contract type?
- What effect does such a contract have on subvendors to the prime? (i.e., Were they forced to go FP?)
- What effect has such government actions, and the resultant low ROE or losses by industry, had on companies willing to do defense contract work?

Additional research on the Allison engine contract might also prove to be beneficial in examining the interaction of contractors striving for a common goal.

APPENDIX A
Chronology

DECEMBER	1958	XV-3 FIRST FULL INFLIGHT CONVERSION FROM HELICOPTER TO FIXED WING AIRCRAFT
	1972	DEPARTMENT OF THE ARMY AND NASA AWARDED BELL HELICOPTER CONTRACT TO DEVELOP TWO XV-15 TILTROTOR DEMONSTRATORS
APRIL	1977	XV-15 FIRST HOVER FLIGHT
JULY	1979	XV-15 FULL IN-FLIGHT CONVERSION FROM HELICOPTER TO FIXED WING AIRCRAFT
	1980	BOTH XV-15 DEMONSTRATORS MEET THEIR PREDICTED SPEED AND ALTITUDE: 300 KNOTS - 16,000 FEET
	1981	PARIS AIR SHOW DEMONSTRATION OF XV-15
		HXM MISSION ELEMENT NEEDS STATEMENT APPROVED BY DOD
		HXM HELICOPTER WEAPON SYSTEM PROJECT OFFICE ESTABLISHED
JUNE	1981	PROGRAM MANAGER ASSIGNED TO HXM PROJECT
AUGUST	1981	UNDER SECRETARY OF DEFENSE (RESEARCH AND ENGINEERING) MEMORANDUM FOR COMMON SOLUTION CONSIDERATION ON NAVY AND AIR FORCE REQUIREMENTS OF ROTARY WING MISSIONS

DECEMBER	1981	MILESTONE 0 – DEPUTY SECRETARY OF DEFENSE DECISION MEMORANDUM ESTABLISHING THE JOINT SERVICES AIRCRAFT PROGRAM (JVX)
DECEMBER	1981	BOEING AWARDED NASA CONTRACT TO DEVELOP ADVANCED TECHNOLOGY COMPOSITE PROPROTOR BLADES FOR THE XV-15
FEBRUARY	1982	JOINT TECHNOLOGY ASSESSMENT GROUP (JTAG) COMPRISED OF ALL SERVICES CONVENE TO DISCUSS ALTERNATIVE DESIGNS FOR ALL SERVICE AIRCRAFT
MAY	1982	JTAG CHOOSES TILTROTOR DESIGN AS BEST ALTERNATIVE
		PRE-BIDDERS CONFERENCE HELD
		TEAMING AGREEMENT SIGNED BY BELL HELICOPTER TEXTRON, INC. AND BOEING-VERTOL COMPANY
JUNE	1982	ARMY, NAVY AND AIR FORCE SIGN A MEMORANDUM OF UNDERSTANDING ON THE JVX ARMY DESIGNATED EXECUTIVE SERVICE
		PROGRAM MANAGER DESIGNATED FOR JVX
SEPTEMBER	1982	CHIEF OF NAVAL OPERATIONS EXECUTIVE BOARD (CED) MEETS TO DISCUSS JVX
		JVX ACQUISITION STRATEGY APPROVED BY CHIEF OF NAVAL MATERIAL
NOVEMBER	1982	OFFICE OF THE SECRETARY OF DEFENSE HOLDS PROGRAM REVIEW

DECEMBER	1982	SDDM APPROVES THE ARMY'S JOINT SERVICES ACQUISITION STRATEGY
		JOINT SERVICES OPERATIONAL REQUIREMENT SIGNED
		NAVY REPLACES ARMY AS THE EXECUTIVE SERVICE
		NAVY JVX CONTRACTING OFFICER APPOINTED
		NAVY CHANGES THE ARMY'S CONTRACT STRATEGY FROM FIXED PRICE LEVEL OF EFFORT TO COST-PLUS
		MILESTONE I - SDDM DIRECTS A DEFENSE SYSTEMS ACQUISITION REVIEW COUNCIL (DSARC) REVIEW FOR APPROVAL FULL-SCALE DEVELOPMENT OF JVX PROGRAM
JANUARY	1983	NAVAL AIR SYSTEMS COMMAND APPROVES ACQUISITION STRATEGY
		REQUESTS FOR PRELIMINARY DESIGN PROPOSALS ISSUED
FEBRUARY	1983	SECOND NAVY CONTRACTING OFFICER APPOINTED
		BELL-BOEING TEAM SUBMITS ONLY PROPOSAL FOR PRELIMINARY DESIGN
APRIL	1983	PRELIMINARY DESIGN CONTRACT PHASE I AWARDED TO BELL-BOEING TEAM
		EXTENSIVE WIND TUNNEL TESTS BEGIN AT BELL-BOEING
MAY	1983	ARMY WITHDRAWS FROM JVX PROGRAM

SEPTEMBER	1983	DEFENSE RESOURCES BOARD (DRB) APPROVES CONTINUATION OF JVX DEVELOPMENT AS A JOINT NAVY/AIR FORCE PROGRAM WITH FULL FUNDING FOR COMMON DEVELOPMENT AND NAVY HAVING TOTAL OBLIGATION AUTHORITY
		WORK STOPPED ON ARMY UNIQUE REQUIREMENTS
NOVEMBER	1983	$88.6 MILLION IN RDT&E PROVIDED IN FISCAL YEAR 1984
MAY	1984	PRELIMINARY DESIGN CONTRACT PHASE II AWARDED
		RFP ISSUED FOR FULL SCALE DEVELOPMENT
JUNE	1984	NAVAL AIR SYSTEMS COMMAND APPROVES MODIFIED ACQUISITION STRATEGY A-42-37-0-40
AUGUST	1984	CHIEF OF NAVAL MATERIAL APPROVES MODIFIED ACQUISITION STRATEGY
SEPTEMBER	1984	REVISED RFP RELEASED TO BELL-BOEING TEAM FOR FULL-SCALE DEVELOPMENT
NOVEMBER	1984	PROGRAM MANAGER'S CHARTER SIGNED
		"OSPREY" SELECTED AS POPULAR NAME BY SECRETARY OF NAVY
JANUARY	1985	OSPREY DESIGNATED "V-22"
FEBRUARY	1985	COST-PLUS-INCENTIVE-FEE CONTRACT PROPOSAL SUBMITTED BY BELL-BOEING

JUNE	1985	FSD EFFORT STARTED AT BELL-BOEING
SEPTEMBER	1985	SECRETARY OF NAVY DIRECTS FIXED-PRICE TYPE CONTRACT BE UTILIZED FOR FSD EFFORT
DECEMBER	1985	ALLISON ENGINE SELECTED
APRIL	1986	MILESTONE II REVIEW HELD BY THE DSARC COUNCIL
		SAR REFLECTS THE ADDITION OF THE ARMY/AIR FORCE REQUIREMENTS IN ACCORDANCE WITH THE MAY 1986 DCP
MAY	1986	SDDM APPROVES FULL-SCALE DEVELOPMENT OF V-22 OSPREY
		FSD CONTRACT SIGNED WITH BELL-BOEING TEAM
		ALLISON ENGINE CONTRACT SIGNED
NOVEMBER	1986	NTE OPTIONS FOR FIRST THREE LOTS OF AIRCRAFT PRODUCTION NEGOTIATED AND SUBMITTED - TO BE INCORPORATED IN THE FSD CONTRACT
DECEMBER	1986	CRITICAL DESIGN REVIEW COMPLETED
		JOINT REQUIREMENTS AND MANAGEMENT BOARD AUTHORIZES CONTINUANCE OF THE DEVELOPMENT PROGRAM

FEBRUARY	1988	ARMY WITHDRAWS FROM THE PROGRAM (STATED HIGHER PRIORITY REQUIREMENTS AND CONSTRAINED FISCAL SITUATION)
MAY	1988	V-22 OSPREY ROLLOUT AT BELL HELICOPTER, ARLINGTON, TEXAS
JULY	1988	PROGRAM BUDGET DECISION FOR FY-89 APPROVES SOLE SOURCE PROCUREMENT PROFILE
SEPTEMBER	1988	JOINT CONFERENCE COMMITTEE DIRECTS THE UNDER SECRETARY OF DEFENSE FOR ACQUISITION (USDA) TO REVIEW THE V-22 ACQUISITION STRATEGY AND DETERMINE IF COMPETITION IS STILL WARRANTED
DECEMBER	1988	BELL-BOEING TEAM SUBMITS NEW NOT-TO-EXCEEDS (NTEs) FOR 12 CO-PRODUCED AIRCRAFT
JANUARY	1989	UNDER SECRETARY OF NAVY DIRECTS PROCUREMENT USING A COMPETITIVE ACQUISITION STRATEGY
		PRESIDENT'S BUDGET IS SUBMITTED TO CONGRESS V-22 IS SUBMITTED IN ACCORDANCE WITH THE SOLE SOURCE PROFILE APPROVED AT 14 JULY 1988 PBD
		ENGINE PRODUCTION CONTRACT AWARDED TO ALLISON - EXERCISE LOT PRODUCTION BY PLACING LONG LEAD FUNDS (LLF) AGAINST THE CONTRACT

FEBRUARY	1989	LLF PLACED AGAINST AIRFRAME CONTRACT - OPTIONS 301/302 EXERCISED
MARCH	1989	ACQUISITION PLAN REVISED TO SOLE SOURCE PROFILE
		SUCCESSFUL FIRST FLIGHT CONDUCTED AT BELL HELICOPTER, ARLINGTON, TEXAS
		REVISED R&D TEST AND EVALUATION MASTER PLAN (TEMP) APPROVED
APRIL	1989	TENTATIVE DRB DECISION TO CANCEL PROGRAM
		DEPARTMENT OF NAVY RECLAMA TO OSD
		DRB DECISION TO CANCEL PROGRAM
		UNANIMOUS "SENSE OF THE SENATE" RESOLUTION PASSED SUPPORTING RESTORATION OF V-22 PROGRAM
NOVEMBER	1989	CONGRESSIONAL COMMITTEES APPROVE $255 MILLION FOR CONTINUATION OF R&D EFFORT

APPENDIX B
List of Acronyms/Definitions

ACAT	Acquisition Category
AP	Acquisition Plan
ARB	Acquisition Review Board
CDR	Critical Design Review
CEB	CNO Executive Board
CO	Contracting Officer
CPAF	Cost Plus Award Fee
CPFF	Cost Plus Fixed Fee
CPIF	Cost Plus Incentive Fee
DCP	Decision Coordinating Paper
DLSIE	Defense Logistics Studies Information Exchange
DOD	Department of Defense
DON	Department of the Navy
DRB	Defense Resources Board
DSD	Deputy Secretary of Defense
DT	Development Test

ECP	Engineering Change Proposal
FFP	Firm Fixed Price
FP	Fixed-Price
FPIF	Fixed-Price Incentive Firm
FSD	Full-Scale Development (Phase)
GFE	Government-Furnished Equipment
ILS	Integrated Logistics Support
JTAG	Joint Technology Assessment Group
LCC	Life-Cycle Cost
LLF	Long Lead Funds
LOE	Level of Effort
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NAVAIR	Naval Air Systems Command
NASA	National Air and Space Administration
NTE	Not-to-exceed
OSD	Office of the Secretary of Defense
OT&E	Operational Test and Evaluation

PD	Preliminary Design
PDR	Preliminary Design Review
PM	Program Manager
PTA	Point of Total Assumption
RDT&E	Research, Development, Test and Evaluation
RFP	Request For Proposal
SAR	Selected Acquisition Report
SDDM	SECDEF Decision Memorandum
SECDEF	Secretary of Defense
SECNAV	Secretary of the Navy
SOW	Statement of Work
ST	Special Tooling
STE	Special Test Equipment
SYSCOM	Systems Command
TDP	Technical Data Package
TEMP	Test and Evaluation Master Plan
USD(R&E)	Under Secretary of Defense (Research and Engineering)

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